CRL's Planned Contribution to GPM

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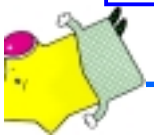
1. Objectives
2. Program Plan of CRL

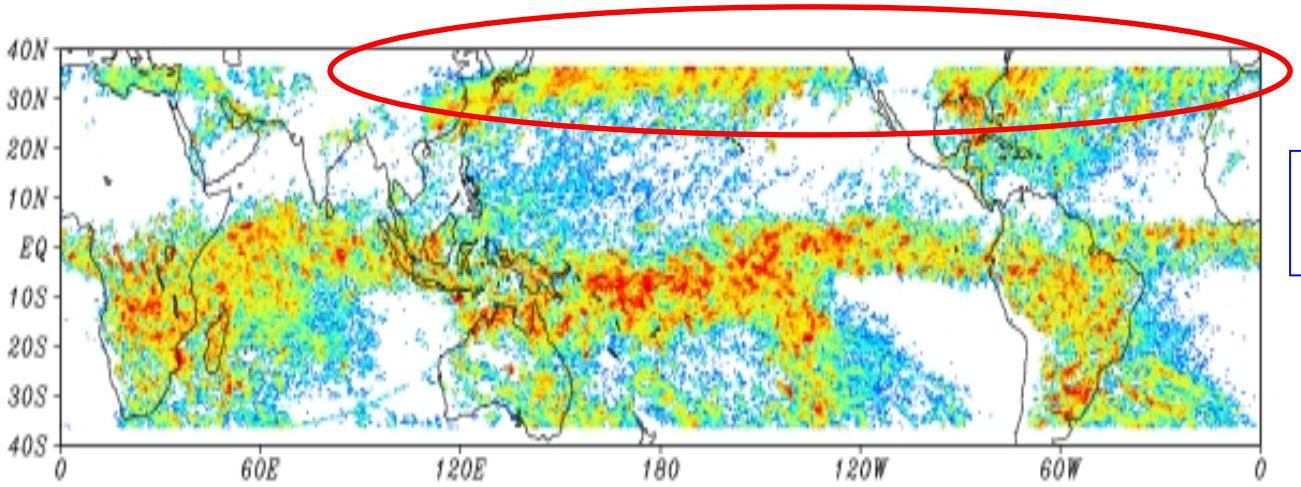
Objectives of GPM/ATMOS-A in Japan

1. Understanding and monitoring of climate and meteorological processes having an direct influence on Japan, i.e. East Asia, Siberia, West Pacific.
2. Understanding of water and energy cycle having an influence on Global Change.

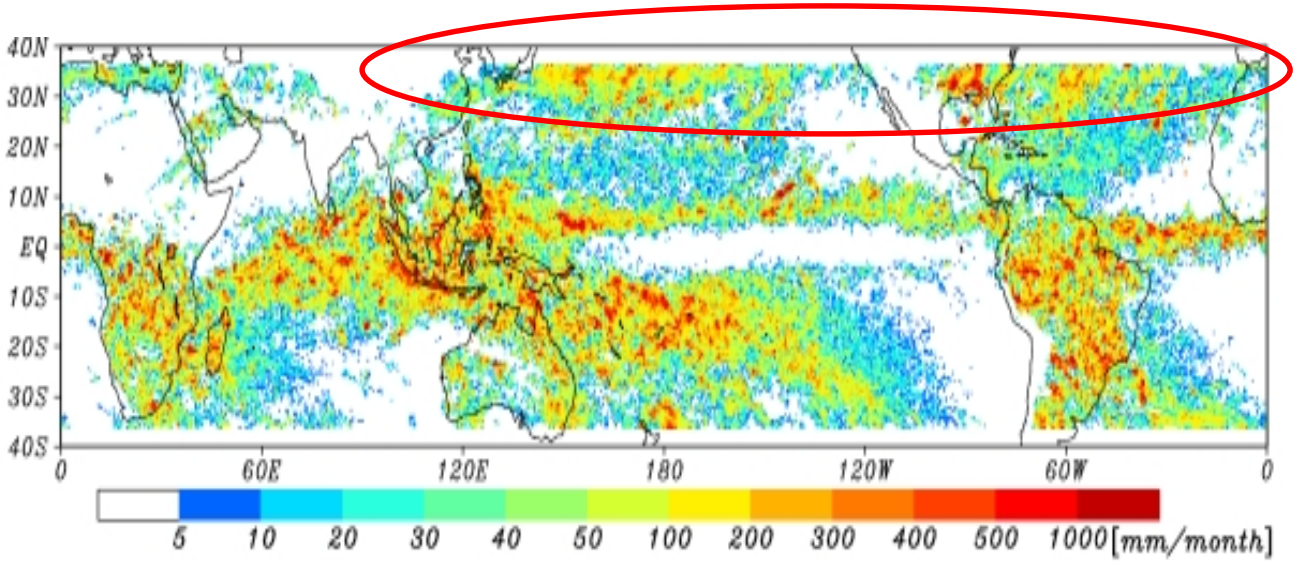
1. Observations of higher latitude regions including over land in the northern hemisphere.
2. Accurate observation with wide dynamic range, i.e. from strong rainfall in the tropics to weak rainfall and snowfall in the higher latitude regions.



Rain distributions in the El Nino year and ordinary year measured with the TRMM PR



El Nino year, January 1998, Rain distribution at altitude of 2 km



Ordinary year, January 1999, Rain distribution at altitude of 2 km

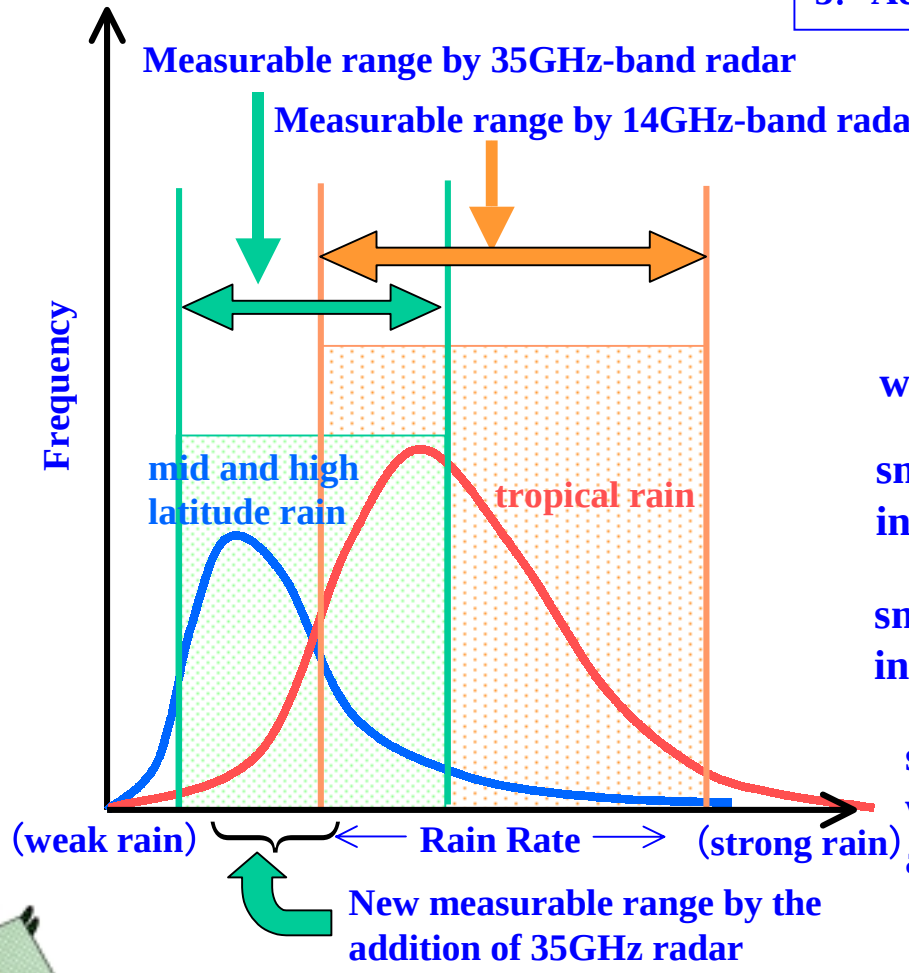
Advantages of Dual-Frequency Radar

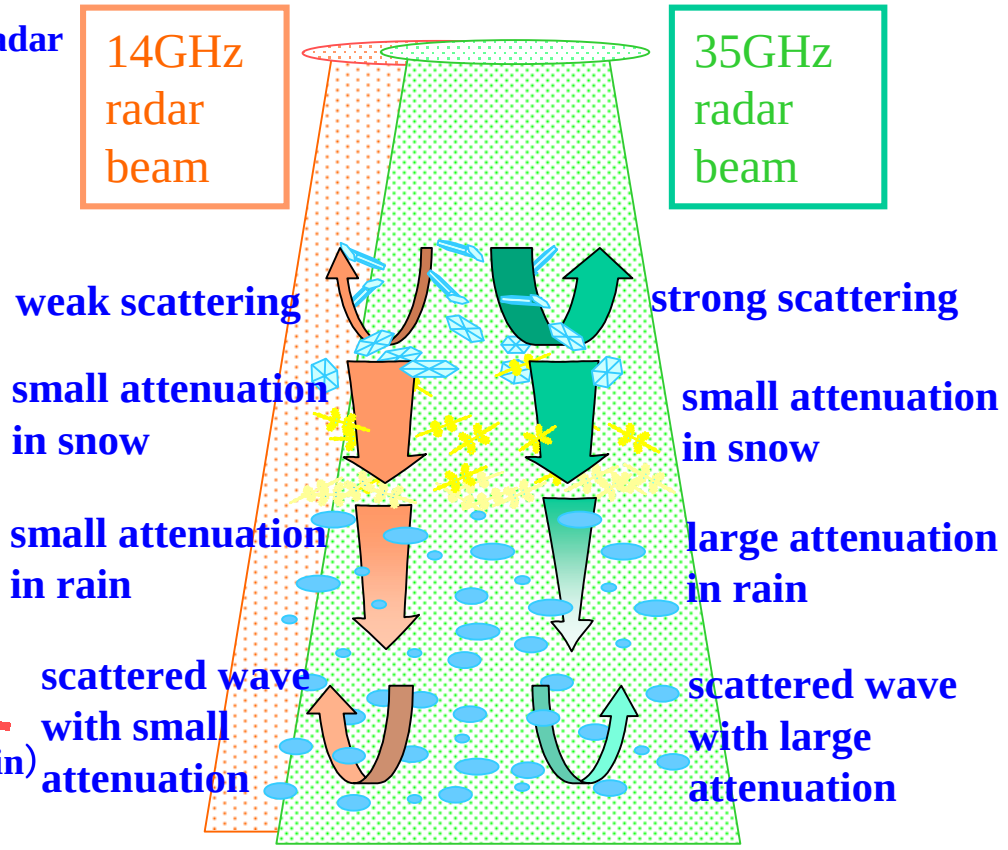
1. Ka-band radar: sensitive measurement of weak rainfall and snowfall.
2. Dual-frequency analysis: accurate quantitative measurement.
   - Combination of reflectivity and attenuation.
   - Estimation of drop size distribution.
3. Difference of Ku- and Ka-band characteristics: discrimination of rain and ice
4. Increase of precision of radiometer observation

Merits of Dual-Frequency Radar Measurement

35 GHz-band radar is needed to measure weak rain in mid and high latitude regions.

1. High sensitivity by the use of high frequency
2. Discrimination between rain and snow by attenuation difference
3. Accurate estimation of rainfall rate by attenuation difference

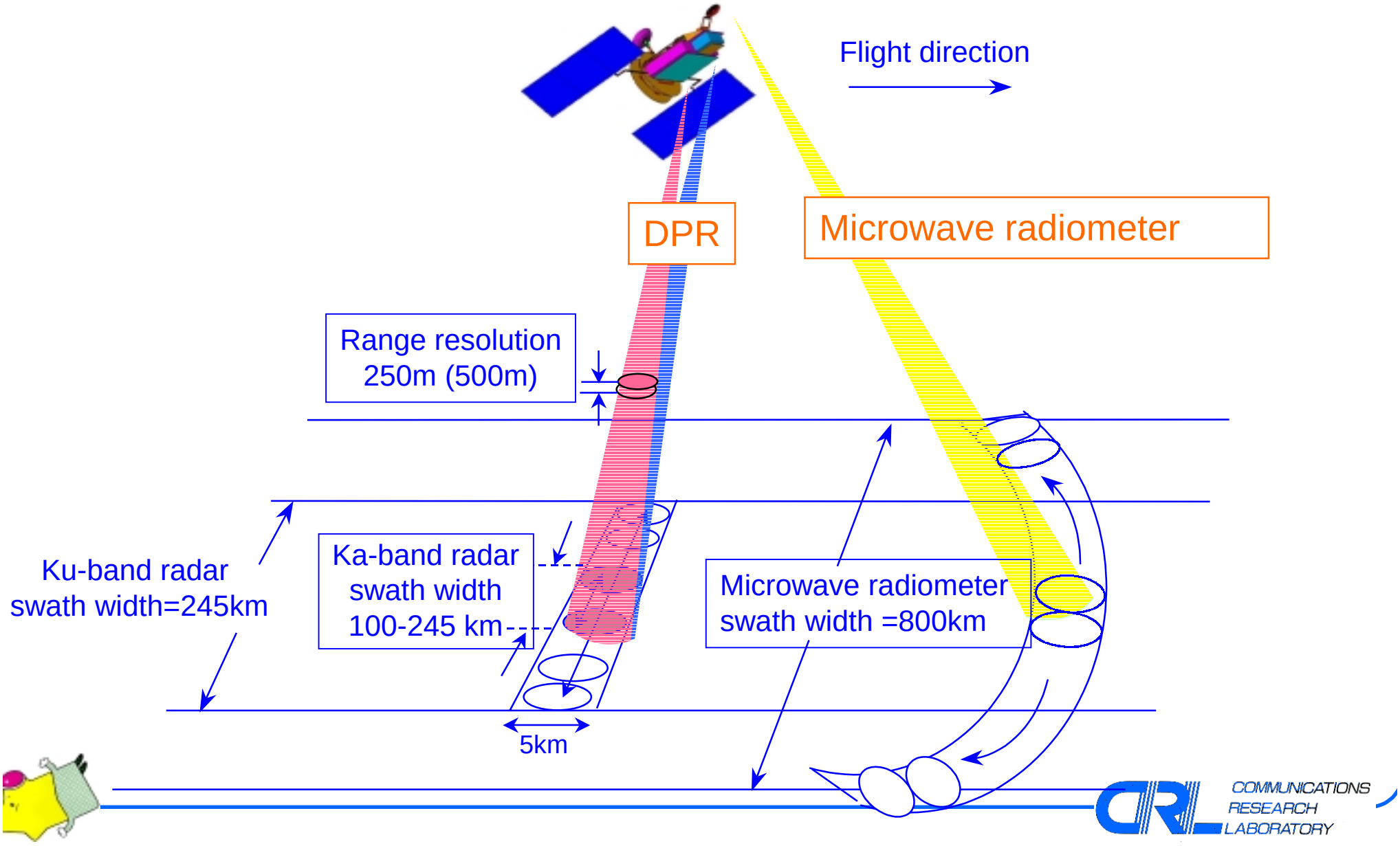




Basic Design of Dual-frequency Radar

1. Ku-band and Ka-band
2. Same design and characteristics for Ku-band as TRMM PR
3. Same design concept for Ku- and Ka-band
   - Active phased-array system using SSPA
   - No use of pulse compression
   - Flexibility in scanning and range resolution
4. Matched beams of Ku- and Ka-band
5. Independent unit
   - Convenient for test and inspection

Conceptual illustration of GPM/Core observation



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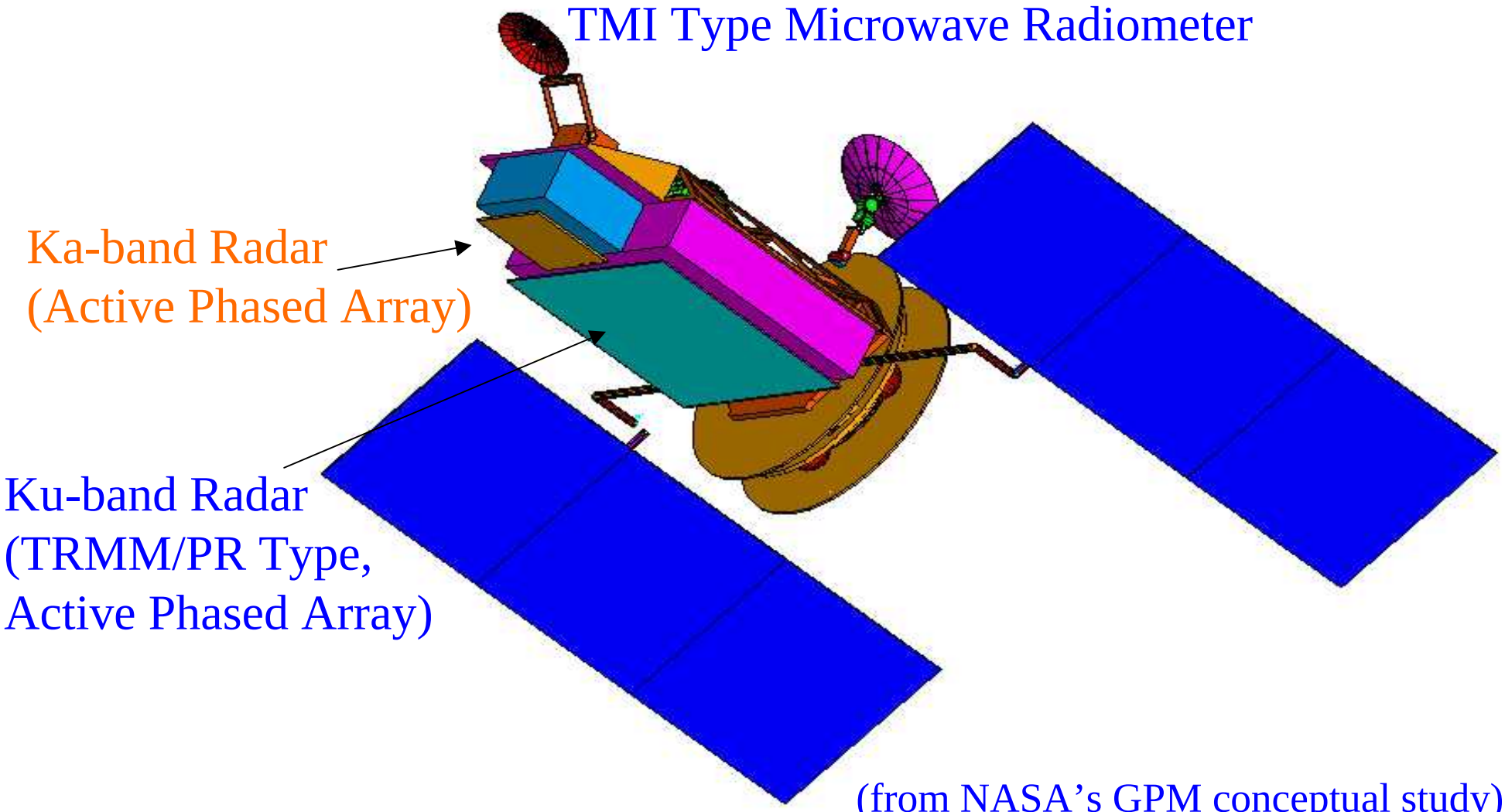
Conceptual Image of Atmos-A1(GPM/Core)



(from NASA's GPM conceptual study)

Specification of DPR (Tentative)

Item	Ku-band PR(PR-U)	Ka-band PR(PR-A)
Antenna Type	Slotted wave-guide	Slotted wave-guide
Scan	Active Phased Array	Active Phased Array
Frequency Band	13.6 GHz	35.55 GHz
Beam Number	49	49
Swath Width	245 km	100-245 km
Pulse Width	1.6 μ sec. (x2)	1.6 (3.2) μ sec. (x2)
Range Resolution	250 m	250 m (500 m)
Beam Width	0.7 deg.	0.7 deg.
Horizontal Resolution	5 km	5 km
PRF	2445Hz	2445Hz

Specifications of DPR (Tentative, continued)

Item	Ku-band PR(PR-U)	Ka-band PR(PR-A)
Peak Power	1000W	180W
Sensitivity (present estimate)	17dBZ	11dBZ (15dBZ for 250 m Res.)
Data Rate	95 kbps	95 kbps
Weight	370 kg	220kg (290kg)
Power Consumption	320 W	200 W (250W)
Size	2.4×2.4×0.5 m	1.0 ×1.0 ×0.5m

• Issues in Development

- 1. System Design
- - Reduction in power consumption and mass
- - To increase the output of SSPA for higher sensitivity
- - Installation procedure for accurate beam matching
- - Trade-off estimation: sensitivity vs. swath width and vertical resolution
- 2. Science issues
- - Clarification of Science products
- - Dual-Frequency Algorithm
- - Combining DPR and TMI Information
- 3. Schedule and cost estimation
- 4. Work sharing between CRL and NASDA

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CRL's Commitment in FY 2000 to 2001

- 1. Ka-band radar development (Designing and testing key components of the 35GHz radar)
  - - Examination of basic overall configuration and performance (FY2000-2001)
  - - Feasibility of pulse compression (FY2000): No use
  - - Designing and testing critical components (FY2000)
  - * SSPA (>2.5 W): 2.6-3.3 W
  - * Phase shifter (5 bits): phase error of 1.3-4.5 deg. for temperature between
  - -20 and +50 deg.C
  - * Antenna (0.9 m): Enough heat, mechanical, and electrical performance
  - - Examination of other critical components and integrated system (FY2001)
  - - Evaluation of performance by simulation (FY2000-2001)
  - - Basic design of sensor and installation process (FY2001)
- 2. Dual-frequency algorithm development
  - - Re-examination of CRL-NASA dual-frequency radar data
  - - Simulation study of satellite observation

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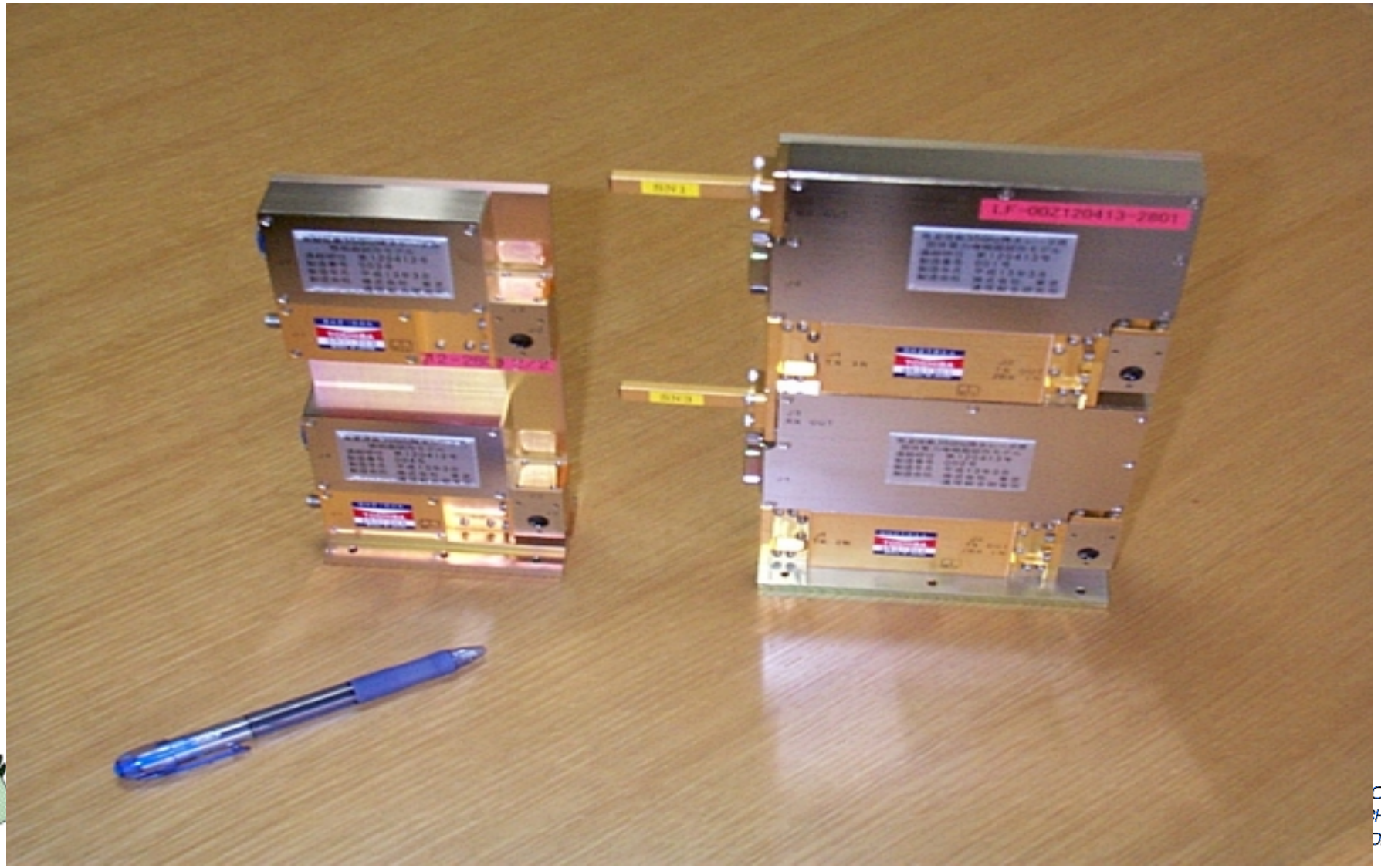
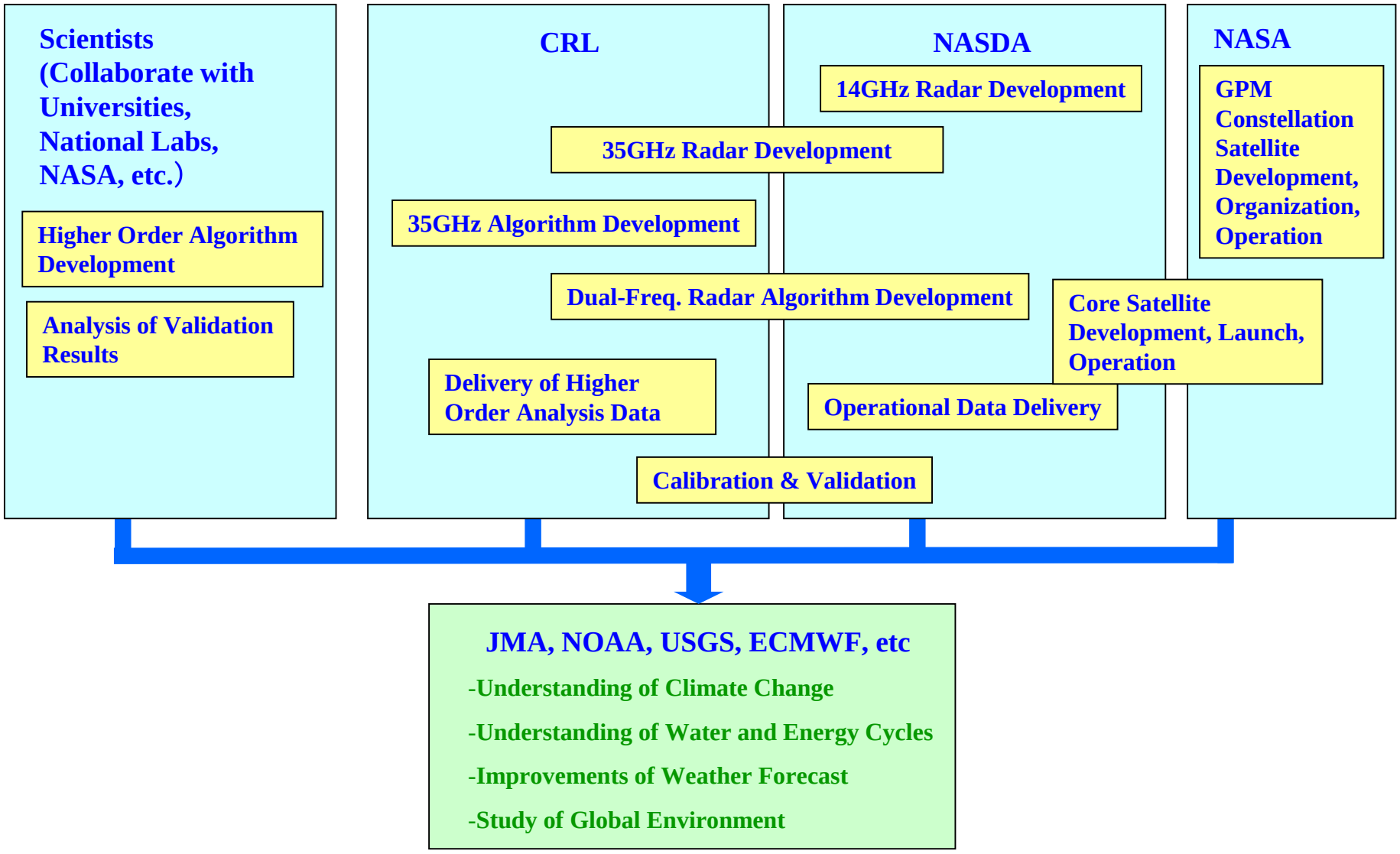
Phase Shifter and SSPA





Program Structure of GPM/ATOMOS-A (Tentative)



Summary

1. Observation of precipitation over higher latitude regions is required for climate study, improved meteorological forecast, and understanding of water and energy cycle around Japan.
2. Dual-frequency radar operated at 14GHz and 35GHz-band is suitable for accurate estimation of weak rainfall and snowfall.
3. CRL has started practical procedure for development of 35GHz-band system from 2000 in collaboration with NASDA.
4. Active phased array with SSPA is used for the 35GHz radar.
5. Trade-off estimation may be needed for sensitivity vs. swath width and vertical resolution.